Common Gateway Services CSCI

Thor DP2

Version 2.0
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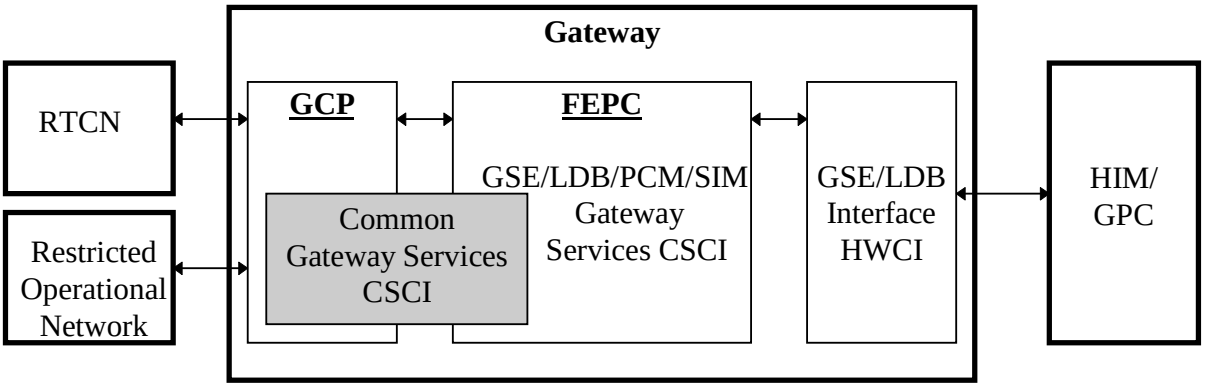
1. Common Gateway Services CSCI

1.1 Common Gateway Services CSCI Introduction

1.1.1 Common Gateway Services CSCI Overview

The Gateway Common Services CSCI provides the essential functions to make any CLCS gateway operational. It is resident on both the Gateway Control Processor (GCP) and the Front End Process Controller (FEPC). The Gateway Common Services CSCI is composed of multiple concurrent tasks that perform individual functions in order to support all the resources in the Gateway.



1.1.2 Common Gateway Services CSCI Operational Description

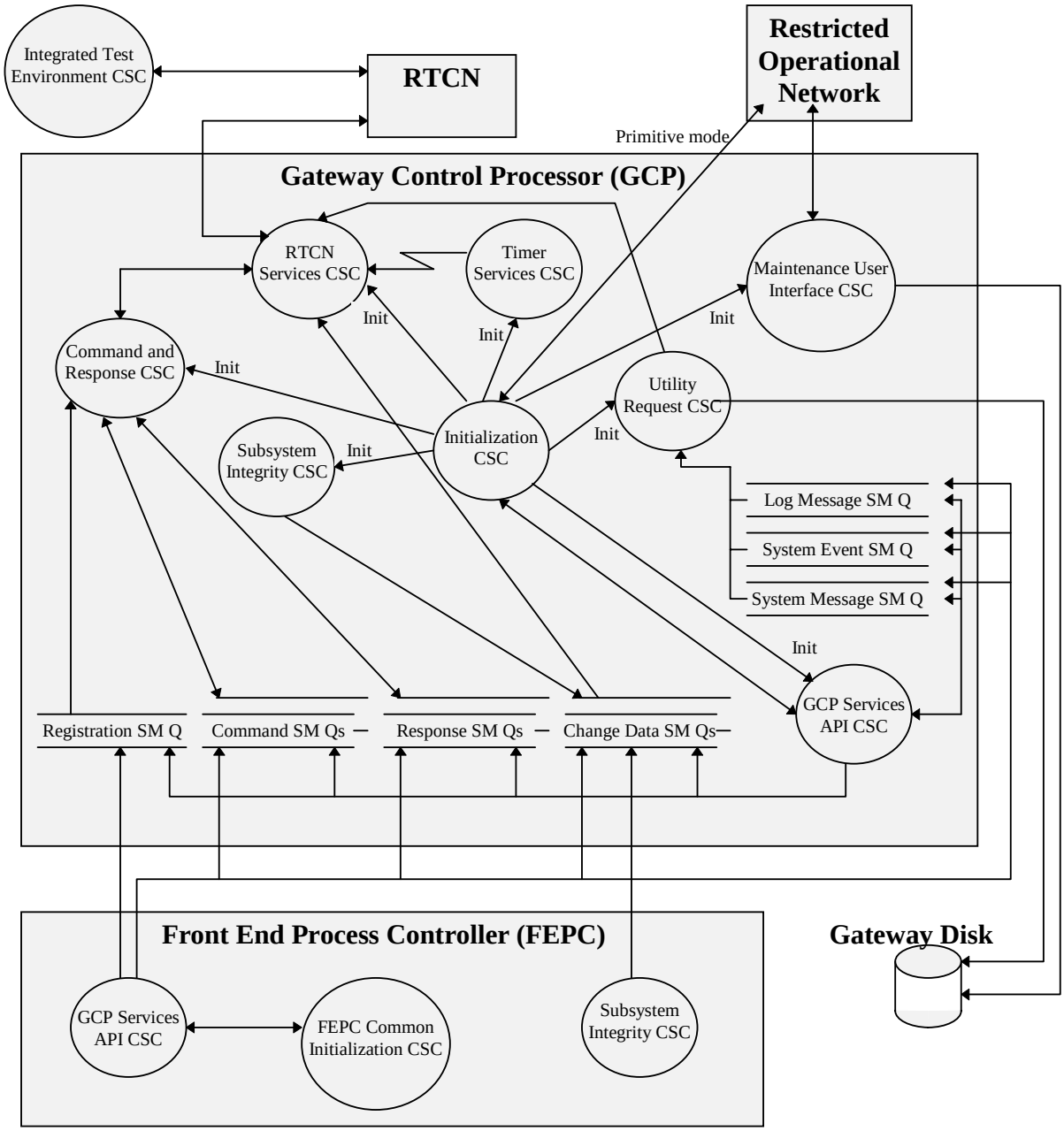
The Common Gateway Services CSCI is initiated by the Real Time Operating System (RTOS) resident on the Gateway's local disk. Initially it will spawn all the necessary tasks to support the Gateway services. All network interfaces for the Gateway are also provided by the Common Gateway Services CSCI.

During Initialization, all Common Gateway Services CSCs are spawned. Each Gateway resident processor registers its initialization parameters using the Registration Shared Memory Message Queue through the GCP Services API CSC. The FEPC Common Initialization CSC accomplishes this for all FEPCs in CLCS. It is a generic set of Initialization routines which is applicable across unique FEPC types. The Gateway Initialization CSC also registers a command processing function for the GCP. In the case of a failure during Boot or SCID Initialization, the Gateway will enter the primitive mode and will minimal operating system functionality over the Restricted Operational Network.

All Commands incoming to the Gateway are received asynchronously over the RTCN through the RTCN Services CSC. Commands are passed to the Command and Response CSC and then forwarded to the correct Gateway processor via the Command Shared Memory Message Queues. The Gateway resident processors read out the Commands using the GCP Services API CSC. The Gateway resident processor generates responses to the issuer of the command using the GCP Services API CSC. This places the outgoing response in the Response Queues where it will be read by the Command and Response CSC and forwarded to the RTCN Services CSC for transmission over the RTCN.

Change Data is generated by the Gateway resident processor and is placed on the Change Data Queues using the GCP Services API CSC. The RTCN Services CSC is then responsible for reading Change Data entries off the Queue, building a Change Data packet, and sending it over the RTCN at the System Synchronous Rate. The System Synchronous Rate will be provided as a software interrupt by the Timer Services CSC.

Gateway Health and Status will be accomplished by the Subsystem Integrity CSC. This CSC is responsible for task monitoring, and tracking processor health counts. All health and status information is transmitted as Change Data packets and uses the Change Data path of communication described above.



The Utility Request CSC provides several generic capabilities to all resources in the Gateway. Error/message logging, System Messages, and System Event messages are all provided. This CSC also contains a Recovery Dump facility which will log all task, variable, and system information to the Gateway disk if a fatal error occurs oin the Gateway.

The Integrated Gateway Test Environment CSC provides a means of emulating the CCP, DDP, and Ops CM server. It operates over the RTCN on any machine that is not a Gateway. Command and Control and System Control

commands may be sent using this CSC. It also provides an RTCN Analyzer that dumps information on a specific RTCN data stream.

The Maintenance User Interface CSC provides a network server for access to the Gateway over the Restricted Operational Network. This interface provides extensive CSC monitoring and Gateway Disk inspection capabilities. The capabilities to access verbose error messages, and decode Recovery Dumps are all accomplished by this Interface. It also provides limited internal commanding capabilities.

1.2 Common Gateway Services Computer Software Components (CSCs)

Common Gateway Services CSCI is composed of the following CSCs:

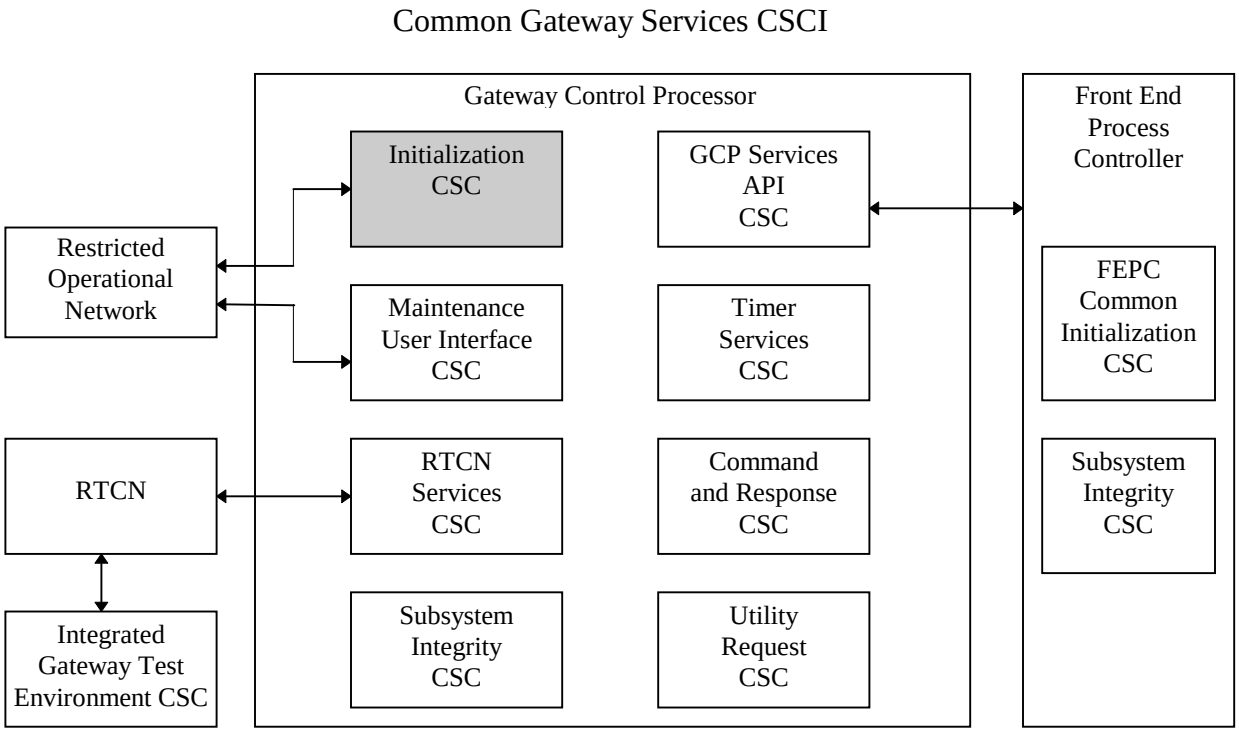
- Gateway Initialization CSC
- FEPC Common Initialization CSC
- Gateway Command and Response CSC
- Gateway RTCN Services CSC
- Gateway Timer Services CSC
- Gateway Subsystem Integrity CSC
- Gateway Utility Request CSC
- GCP Services API CSC
- Gateway Maintenance User Interface CSC
- Integrated Gateway Test Environment CSC

2. Gateway Initialization CSC

2.1 Gateway Initialization CSC Introduction

2.1.1 Gateway Initialization CSC Overview

The Gateway Initialization CSC is responsible for the initialization sequence of the Gateway. It is part of the Common Gateway Services CSCI and is resident in the GCP.



2.1.2 Gateway Initialization CSC Operational Description

The Gateway Initialization CSC controls the initialization sequence of the Gateway. The Gateway's initialization sequence is divided into four (4) modes of operation that allow a synchronized boot sequence between all the Single Board Computers resident in the Gateway. Gateway Initialization CSC also supports a primitive mode that allows recovery from a Boot or SCID Initialization error.

2.2 Gateway Initialization CSC Specifications

2.2.1 Gateway Initialization CSC Groundrules

- SCID and TCID tables will be resident on the local hard drive.
- There will be only one Gateway SCID which will include the VxWorks kernels for each Gateway processor.
- The Gateway Initialization CSC will support the following Initialization Modes in order to synchronize the Gateway's boot sequence:
  - Primitive

  - SCID Initialization
  - SCID/TCID Load
  - Ready
  - Operational

- The Gateway Initialization CSC will support the following initialization commands:
  - Init SCID
  - Init TCID
  - Activate Gateway
  - Terminate Gateway
  - Configuration Status

2.2.2 Gateway Initialization CSC Functional Requirements

The Functional Requirements for the Gateway Initialization CSC are arranged in the following major functions:

1. Primitive mode
2. SCID Initialization mode
3. SCID/TCID Initialization mode
4. Ready mode
5. Operational mode

2.2.2.1 Primitive Mode

The Primitive mode offers the most basic VxWorks operating system services. The Gateway will transition to the Primitive mode only if there is a VxWorks error during boot, or a Common Gateway Services software error during SCID Initialization. Primitive mode includes access to the Gateway via the Restricted Operational Network.

1. In case of a boot failure, or failure during SCID Initialization, the Gateway will transition to the Primitive Mode in order to allow a new SCID to be loaded.
2. The Primitive mode shall support communications (and FTP) via the Restricted Operational Network.
3. The Primitive mode shall support access to the Gateway's Hard Drive.
4. The Primitive mode shall not support communications via the RTCN.

2.2.2.2 SCID Initialization Mode

The SCID Initialization mode is a transitional mode between Gateway boot and the SCID/TCID Load mode. It is in the SCID Initialization mode that the Gateway loads the kernels from the Gateway Hard Drive and spawns the Initialization tasks for both the Gateway Control Processor (GCP), and the Front End Processor Controller (FEPC).

1. Gateway Initialization CSC shall record initialization messages on local storage media.
2. No external commands shall be accepted during the SCID Initialization mode.
3. During SCID Initialization, the Gateway Initialization CSC shall check the Power-Fail Flag in Non-volatile RAM before proceeding with Initialization (Post Thor).
4. During SCID Initialization, all Common Gateway Services CSCs shall be started.
5. During SCID Initialization, the Gateway Initialization CSC shall cyclically attempt to connect with the Ops CM server until a response is received.
6. Gateway Initialization shall receive Mode changes from the Gateway Processors (FEPCs) via the State Change Shared Memory Queue.
7. Gateway Initialization shall transition to SCID/TCID Load mode when SCID software load is complete, connection is established with the Ops CM Server, and the Gateway resident processors have changed to SCID/TCID Load mode.

2.2.2.3 SCID/TCID Load Mode

The SCID/TCID Load mode is the first point at which Ops CM commands are accepted and processed.

1. When in SCID/TCID Load mode, only Init SCID, Init TCID, and Configuration Status commands shall be accepted.
2. When a Configuration Status command is received, the Gateway Initialization CSC shall respond with the current Gateway Initialization mode, the current SCID Version, and the current TCID version (TBD).
3. Gateway Initialization CSC shall perform a reboot and enter SCID Initialization mode when the Init SCID command is received.
4. Gateway Initialization CSC shall perform all Table Loads and other TCID-specific actions when the Init TCID command is received.
5. Gateway Initialization CSC shall transition to Ready Mode when the Init TCID command is successfully completed, and the Gateway resident processors have changed to Ready mode.

2.2.2.4 Ready Mode

The Ready mode indicates that a TCID has been successfully loaded onto the Gateway. The next step is to Activate the Gateway to make it operational.

1. When in Ready mode, only Init SCID, Init TCID, Activate, and Configuration Status commands shall be accepted.
2. When in Ready mode, the Init SCID, Init TCID and Configuration Status commands shall be processed exactly as processed in the SCID/TCID Load mode.
3. Gateway Initialization CSC shall start Change Data generation tasks, System Message tasks, and other Gateway-specific tasks when the Activate command is received.
4. Gateway Initialization CSC shall transition to Operational mode when the Activate command is successfully completed, and the Gateway resident processors have changed to Operational mode.

2.2.2.5 Operational Mode

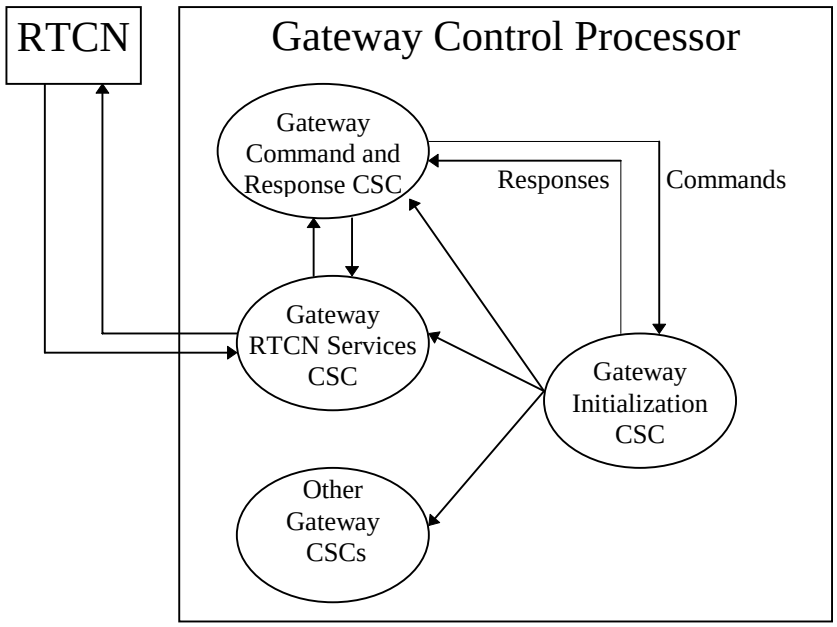
The Operational mode is the state in which the Gateway processes Commands, generates Responses, and outputs Change Data.

1. When in Operational mode, only Terminate, and Configuration Status Initialization commands shall be accepted.
2. When in Operational mode, the Configuration Status command shall be processed exactly as processed in the SCID/TCID Load mode.
3. Gateway Initialization CSC shall halt Change Data generation tasks, halt System Message tasks, halt other Gateway-specific tasks, and perform resource/memory de-allocation when the Terminate command is received.
4. FTP will be disabled while in Operational mode.
5. Gateway Initialization CSC shall record all termination messages on local storage media.
6. Gateway Initialization CSC shall generate a system message prior to a successful termination (Terminate Gateway command).
7. Gateway Initialization CSC shall generate a system message if there is an error in termination.
8. Gateway Initialization CSC shall transition to Ready mode when the Terminate command is successfully completed, and the Gateway resident processors have changed to Ready mode.

2.2.3 Gateway Initialization CSC Performance Requirements

No performance requirements have been identified for the Gateway Initialization CSC for the Thor delivery.

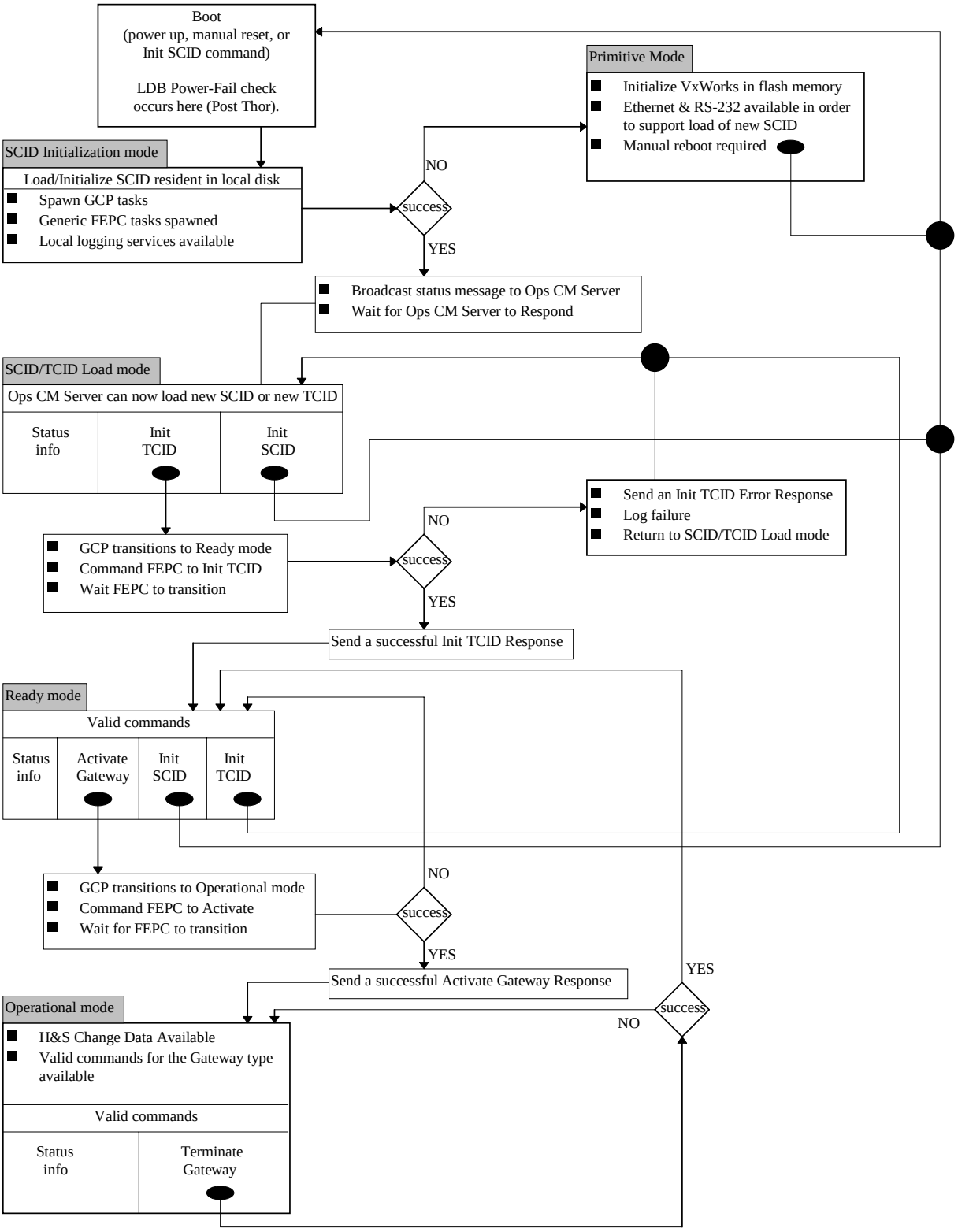
2.2.4 Gateway Initialization CSC Interfaces Data Flow Diagram



Gateway Initialization CSC is the first CSC to be spawned by the Gateway. It is responsible for the creation and termination of all other Gateway CSCs.

Gateway Initialization CSC commands and responses are handled through the Gateway Command and Response CSC.

2.2.5 Gateway Initialization CSC State Diagram

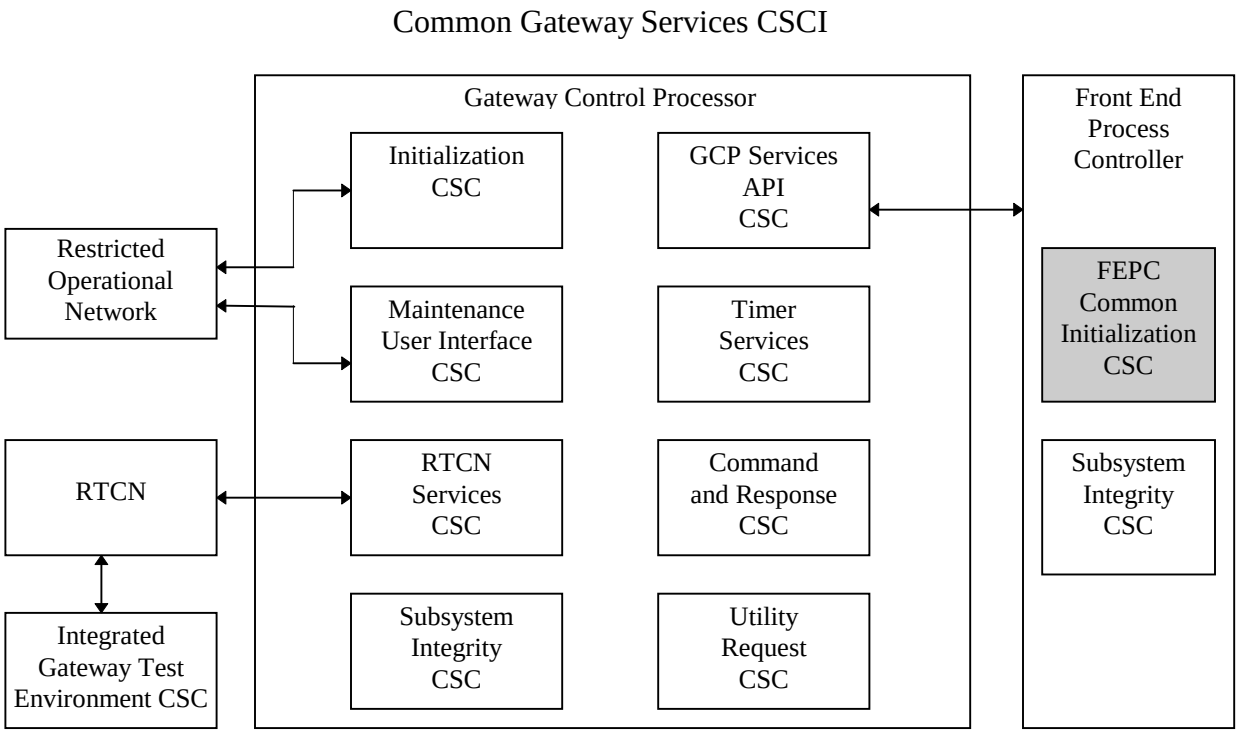


3. FEPC Common Initialization CSC

3.1 FEPC Common Initialization CSC Introduction

3.1.1 FEPC Common Initialization CSC Overview

The FEPC Common Initialization CSC is responsible for the initialization of the Front End Process Controller. The initialization includes all sequencing involved to transition from power-on through operational mode. Gateway specific (GSE, LDB, PCM, etc.) routines will be called as part of the table load command and activate command.



3.1.2 FEPC Common Initialization CSC Operational Description

The FEPC Common Initialization CSC is initialized at subsystem startup by the vxWorks operating system. This CSC will initialize a command processor task. The FEPC Common Initialization CSC will then wait for an initialization command.

The TCID Init command will cause a gateway specific table load command to be executed. Successful completion of this function will cause a transition to ready mode (See mode description below)

The Activate command will cause this CSC to terminate the tasks associated with common initialization and then call a gateway specific activation function. Successful completion of this function will cause a transition to operational mode (See mode description below)

This CSC controls the initialization mode of the FEPC during the startup and load sequence. This mode information is used by all active CSC's to determine the validity of commands.

3.2 FEPC Common Initialization CSC Specifications

3.2.1 FEPC Common Initialization CSC Groundrules

- The gateway specific CSCI (LDB, GSE, PCM, etc.) will provide the table load and activate functions.

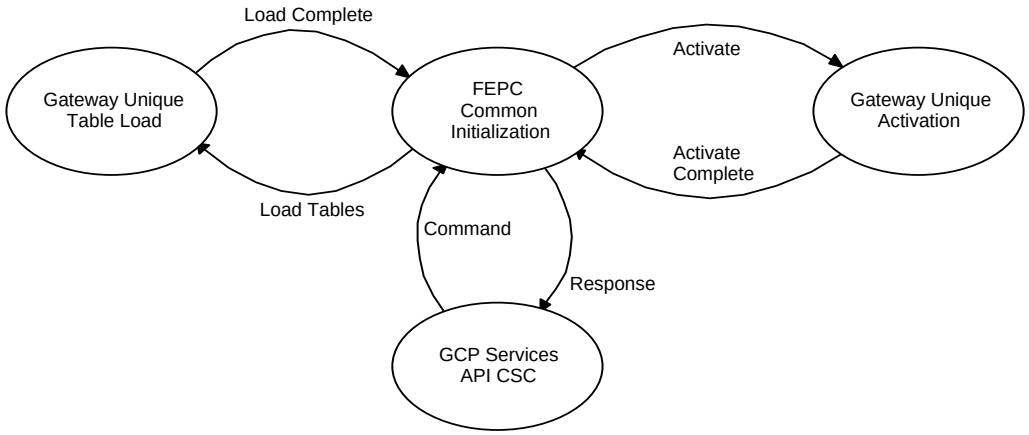
3.2.2 FEPC Common Initialization CSC Functional Requirements

1. FEPC Common Initialization will support the following operating modes:
   - 1.1. Initialization
   - 1.2. Load
   - 1.3. Ready
   - 1.4. Operational
2. FEPC Common Initialization will support the following load and initialize commands:
   - 2.1. Initialize SCID (reboot)
   - 2.2. Initialize TCID (load tables)
   - 2.3. Activate Gateway
   - 2.4. Terminate Gateway
3. FEPC Common Initialization will record initialization messages on local storage media.
4. Only initialization commands will be accepted during the Initialization mode.
5. FEPC Common Initialization will transition to Load mode when SCID software load is complete.
6. When in Load mode, only the Initialize SCID and Initialize TCID commands will be accepted.
7. FEPC Common Initialization will perform a reboot and enter Initialization mode when the Initialize SCID command is received.
8. FEPC Common Initialization will call a gateway type specific table load function as part of the Initialize TCID command.
9. FEPC Common Initialization will transition to Ready mode when the TCID tables are successfully loaded.
10. When in Ready mode, only the Activate Gateway and Terminate Gateway commands will be accepted.
11. FEPC Common Initialization will complete initialization and enter the Operational mode when the Activate Gateway command is received.
12. FEPC Common Initialization will call a gateway type specific activation function as part of the Activate Gateway command.
13. FEPC Common Initialization will terminate upon completion of a successful activation.
14. FEPC Common Initialization will provide a termination function to be called upon completion of the gateway type unique termination function.
15. The FEPC Common Initialization terminate function will restart the FEPC Common Initialization CSC and enter Ready mode.
16. FEPC Common Initialization will generate a system message prior to termination, whether due to an error or by command.
17. FEPC Common Initialization will record all termination messages on local storage media.
18. FEPC Common Initialization will be capable of generating system messages through the Gateway Common Services CSCI using the GCP Services API.
19. FEPC Common Initialization will be capable of requesting through the GCP Services API that a message be written to a file on the local hard drive or the local console port.
20. FEPC Common Initialization will provide the capability to be re-initialized without receiving a new table load command.

3.2.3 FEPC Common Initialization CSC Performance Requirements

No performance requirements have been identified for the FEPC Common Initialization CSC for the Thor delivery.

3.2.4 FEPC Common Initialization CSC Interfaces Data Flow Diagram



The FEPC Common Initialization CSC accepts commands from the RTCN via the GCP Services API CSC which is part of Common Gateway Services CSCI..

The FEPC Common Initialization CSC calls a gateway type unique table load function as part of the Initialize TCID command.

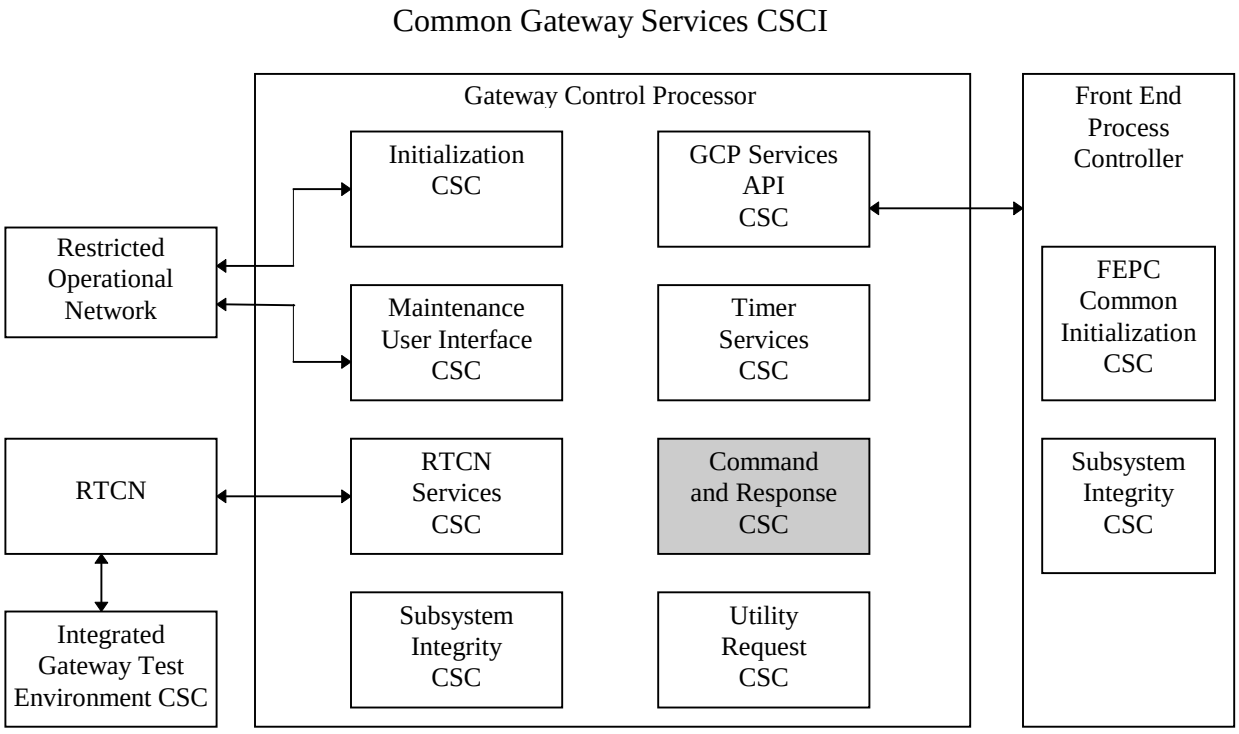
The FEPC Common Initialization CSC calls a gateway type unique activate function as part of the Activate command.

4. Gateway Command and Response CSC

4.1 Gateway Command and Response CSC Introduction

4.1.1 Gateway Command and Response CSC Overview

The Gateway Command and Response CSC is responsible for handling the processing of all commands and the tracking of all responses in the Gateway.



4.1.2 Gateway Command and Response CSC Operational Description

During Gateway initialization, each Gateway resident processor registers the specific command and response services it requires (e.g. route codes, request IDs, command and response queues). All shared memory message queues, a routing table, and a transaction table are built using the registered information.

An incoming RTCN command is indexed into the routing table by its Route Code and Request ID, stored in the transaction table if a response is required, checked for command priority, and relayed to the appropriate Gateway processor(s) command queues. A Gateway resident processor's generated response is indexed into the transaction table by transaction ID to verify a response was expected, and relayed to the RTCN.

The Gateway Command and Response CSC is also capable of relaying to the RTCN any commands issued by the Gateway resident processors, and handling the incoming responses associated with those commands.

4.2 Gateway Command and Response CSC Specifications

4.2.1 Gateway Command and Response CSC Groundrules

- Gateway Command and Response CSC will support a Registration shared memory message queue by which each Gateway resident processor may register for specific Command and Response services. The Gateway resident processors will interface to the Registration queue using functions provided by the GCP Services API CSC.
- Gateway Command and Response CSC will support all RTCN using the Gateway RTCN Services CSC.
- Gateway Command and Response CSC will reserve Route Code 0 for internal Gateway communications. No command with a Route Code of 0 will reach a network.
- Gateway Command and Response CSC communication to other Gateway resident processors will be by shared memory message queues. The Gateway resident processors will interface to these queues using functions provided by the GCP Services API CSC.
- Gateway Command and Response CSC will build and maintain the following tables:
  - Route Table: Maps Route Codes and Request IDs to Gateway resident processors.
  - Transaction Table: Tracks commands and their associated required responses.

4.2.2 Gateway Command and Response CSC Functional Requirements

The Functional Requirements for Gateway Command and Response CSC are arranged in the following major/minor functions:

1. Gateway Processor Registration
2. Command Reception
3. Command Generation
4. Response Reception
5. Response Generation

4.2.2.1 Gateway Processor Registration

Gateway Processor Registration is the means by which Common Gateway Services is aware of the Gateway resident processors or GCP resident processes that need Command and Response capabilities.

1. Gateway Command and Response CSC shall provide a Registration shared memory message queue for Gateway resident processor or GCP resident process registration.
2. Gateway Command and Response CSC shall provide the following services to each Gateway resident processor and to GCP resident processes:
   - 2.1. High and normal priority receive command queues,
   - 2.2. Generate response queue,
   - 2.3. Change data queue,
   - 2.4. High and normal priority generate command queues(limited support in the Thor delivery),
   - 2.5. Receive response queue (limited support in the Thor delivery),
   - 2.6. Route code and Request ID registration.
3. Registration for any command queues shall result in the creation of both a high and normal priority queues.
4. Gateway Command and Response CSC shall build and maintain a Route Table which will contain registered Route Codes and their associated Request IDs for each Gateway resident processor and GCP resident processes.
5. Route Code and Request ID Registration may occur at any time during Gateway processing.
6. Gateway Command and Response CSC shall build and maintain a Transaction Table which will track responses during command processing.

7. For each requested response reception and command generation queue, Gateway Command and Response CSC shall spawn a task to monitor activity on the queue.

4.2.2.2 Command Reception

Gateway Command Reception is the processing of incoming RTCN commands.

1. Gateway Command and Response shall receive commands asynchronously from the RTCN using the API provided by Network Services CSCI.
2. When an incoming command's Route Code is not found in the Route Table, an Invalid Route Code Response shall be returned to the command's source.
3. When an incoming command's Request ID is not found in the Route Table, an Invalid Request ID Response shall be returned to the command's source.
4. When an incoming command's Route Code and Request ID is found in the Route Table, the command shall be forwarded to each processor/process that registered for that Route Code and Request ID.
5. When an incoming command has been designated in the command header as high priority, the command shall be placed in the appropriate processor(s)/process(es) high priority receive command queue.
6. When an incoming command has been designated in the command header as expecting a response, the command's header shall be copied into the Transaction Table for reference during Response Generation.

4.2.2.3 Command Generation

Gateway Command Generation is the processing and sending of outgoing Gateway commands.

1. Gateway Command and Response shall receive commands asynchronously from the Command Generation shared memory message queues using the GCP Services API CSC.
2. In the Thor Delivery, only Internal Route Code (Route Code 0) commands will be processed.
3. All Internal Route Code commands shall be processed as incoming RTCN commands.
4. When an outgoing command has been designated in the command header as expecting a response, the command's header shall be copied into the Transaction Table for reference during Response Reception.

4.2.2.4 Response Reception

Gateway Response Reception is the processing of incoming responses to Gateway commands.

1. In the Thor Delivery, only responses to internally generated commands will be received.
2. Received Responses shall be routed to the Gateway resident processor that generated the command.

4.2.2.5 Response Generation

Gateway Response Generation is the building and sending of outgoing Responses to the commands processed by the Gateway.

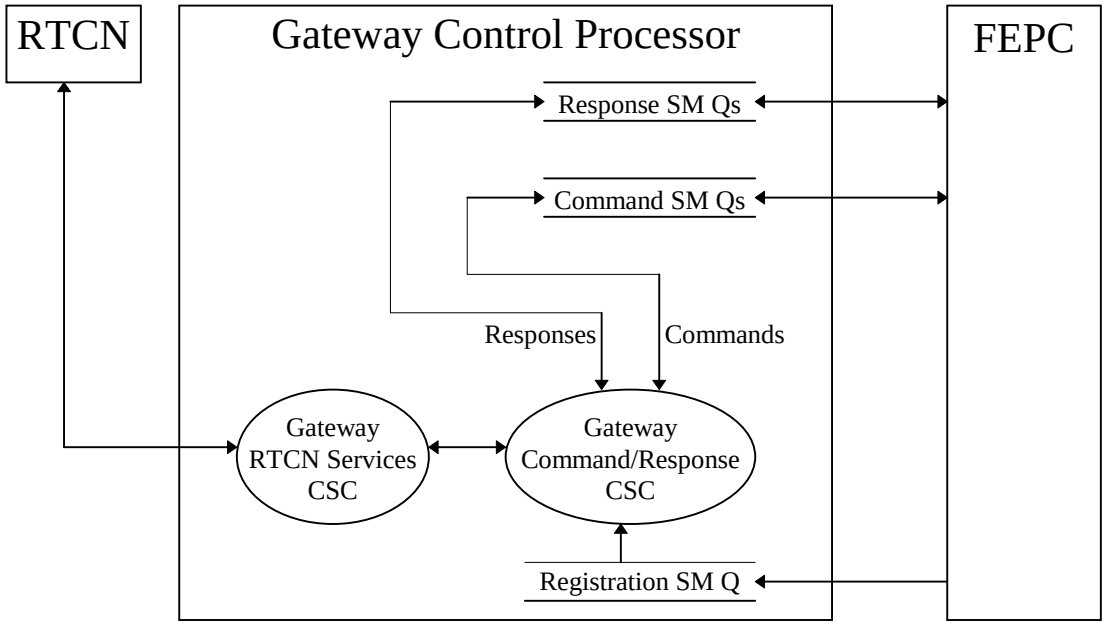
1. Each generate response queue monitor shall read asynchronously from the shared memory message queues.
2. When a generated response is read from the shared memory message queues and not found in the Transaction Table, an Unsolicited Response System Message shall be issued and the Response stored for future access.
3. When a generated response is read from the shared memory message queues and found in the Transaction Table, Gateway Command and Response CSC shall time stamp the packet and write it to the RTCN using the API provided by the Network Services CSCI.
4. When the generated response is one of several expected responses, the response shall be stored in the Transaction Table until all expected responses have been generated. At that time, Gateway Command and Response CSC shall time stamp and send the response to the RTCN.

5. Gateway Command and Response shall support the Command Issued completion code for those commands that require extended periods of time to process.
6. Gateway Command and Response shall support the Continuation bit in the flags field for those commands whose Responses require extremely large payloads.
7. Gateway Command and Response shall support the Command Time-out completion code for those commands that time out while being processed.
8. Gateway Command and Response CSC shall send response packets to the RTCN using the API provided by the Network Services CSCI.
9. All Gateway generated responses will be time stamped immediately prior to transfer to the RTCN. The time stamp will reflect the time the response left the gateway, not when processing occurred.

4.2.3 Gateway Command and Response CSC Performance Requirements

1. Gateway Command and Response CSC shall be capable of processing 500 commands per second.
2. Internal Gateway timeout shall be less than the CCP timeout.

4.2.4 Gateway Command and Response CSC Interfaces Data Flow Diagram



All FEPCs in the Gateway register with the Command and Response CSC using the Registration Shared Memory Message Queue. Registration includes the Route Codes and Request IDs the FEPC is expecting.

RTCN Commands are received by the RTCN Services CSC and forwarded to the Command and Response CSC. The commands are routed to the FEPCs in the Gateway that registered for that Route Code and Request ID via the Command Shared Memory Message Queues. RTCN Responses generated by the FEPC are read from the Response Shared Memory Message Queues by the Command and Response CSC. These are then forwarded to the RTCN using the RTCN Services CSC.

Commands generated by the FEPC are read from the Command Shared Memory Message Queues by the Command and Response CSC. For Thor, these commands will only be internal commands. These will be routed according to

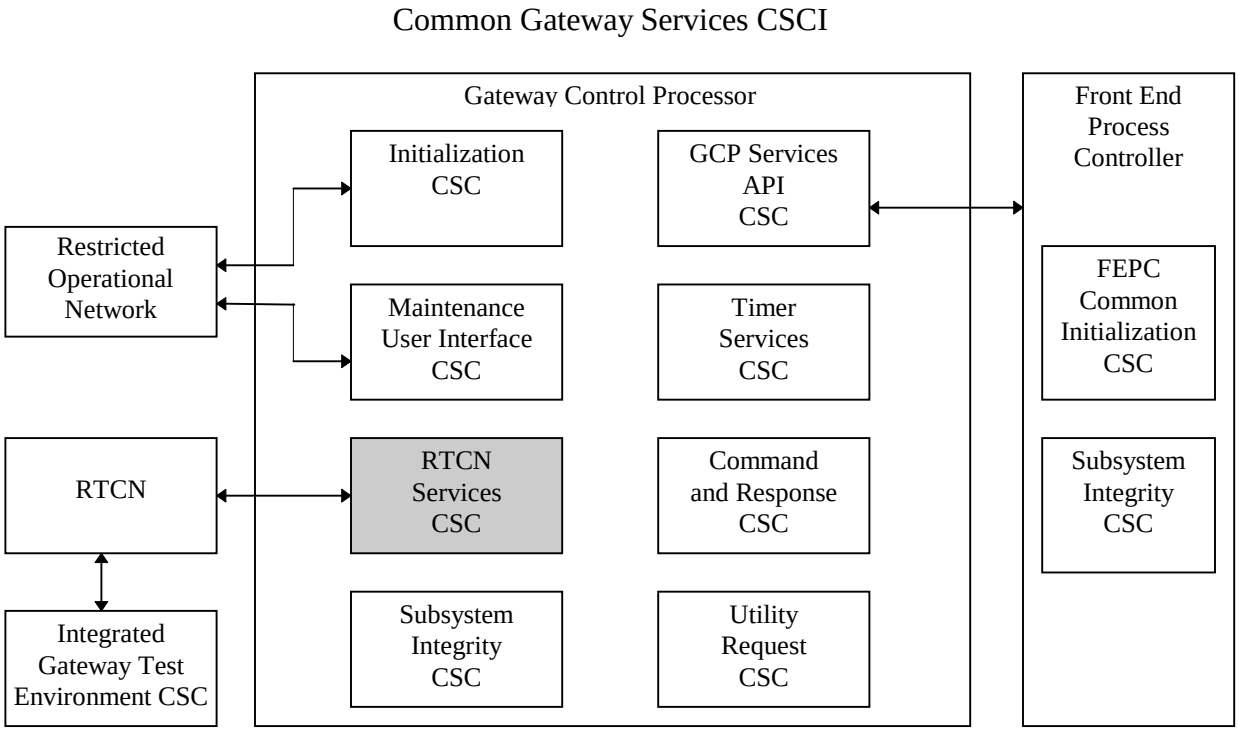
the Request ID of the internal command. Responses received from these commands are received through the Response Shared Memory Message Queues.

5. Gateway RTCN Services CSC

5.1 Gateway RTCN Services CSC Introduction

5.1.1 Gateway RTCN Services CSC Overview

The Gateway RTCN Services CSC is responsible for the different services needed by the Gateway when interfacing with the RTCN. It is also responsible for output of Change Data packets. It is part of the Common Gateway Services CSCI and is resident in the GCP.



5.1.2 Gateway RTCN Services CSC Operational Description

The Gateway RTCN Services CSC contains the API provided by the Network Services CSCI which is used by the Gateway components when interfacing with the RTCN. Also, when interrupted by the Timer Services CSC, the Gateway RTCN Services CSC will build RTCN change data packets and transfer them to the RTCN. These RTCN change data packets contain change measurements provided by the FEPC.

5.2 Gateway RTCN Services CSC Specifications

5.2.1 Gateway RTCN Services CSC Groundrules

- The Network Services CSCI API library used by the Gateway RTCN Services CSC for all communications over the RTCN will be linked as part of the Gateway SCID.
- The Gateway Timer Services CSC will interrupt RTCN Services CSC at the system synchronous rate.
- The FEPC will provide change measurements via the SM Change Data Queue.

5.2.2 Gateway RTCN Services CSC Functional Requirements

The Gateway RTCN Services CSC shall provide change data packets to the RTCN at the system synchronous rate.

The Functional Requirements for the Gateway RTCN Services CSC are arranged in the following major functions:

1. RTCN Interface Functions
2. Change Data Generation

5.2.2.1 RTCN Interface Functions

The RTCN Interface Functions use the Network Services CSCI API to aid other Gateway CSCs in the management of network data streams.

1. Gateway RTCN Services CSC shall provide functions to open and close Gateway network data streams.
2. Gateway RTCN Services shall maintain a Network Streams Table to track the state and activity of each network stream.

5.2.2.2 Change Data Generation

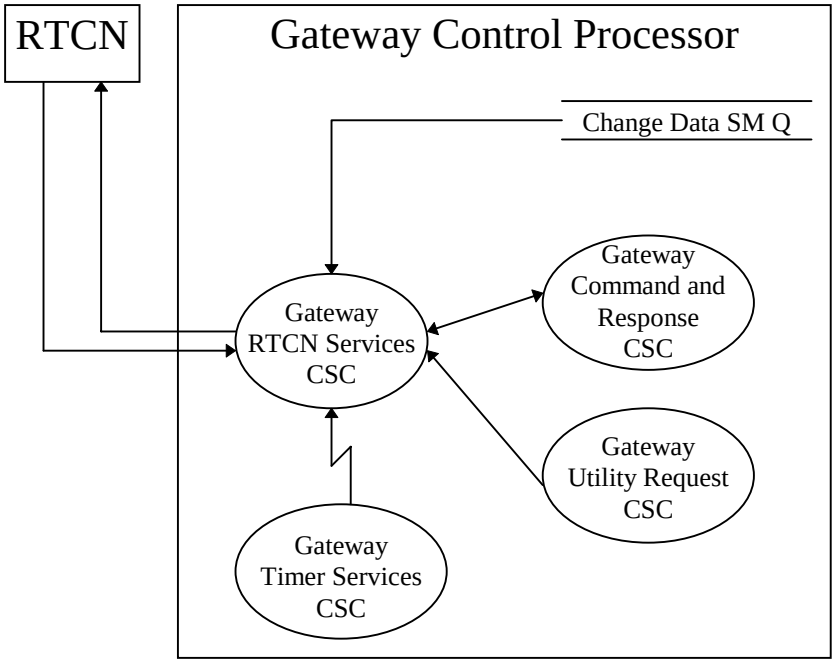
The Change Data Generation functions are responsible for the output of Change Data from the Gateway.

1. Gateway RTCN Services CSC shall receive Change Data entries asynchronously from the Change Data Shared Memory Message Queues.
2. Gateway RTCN Services CSC shall timestamp all received Change Data entries, and add them to the Gateway's outgoing Change Data packet.
3. When necessary, Gateway RTCN Services CSC shall include a millisecond offset time entry into the Change Data packet preceding the appropriate Change Data entry.
4. Gateway RTCN Services CSC shall transmit Change Data packets to the RTCN at the System Synchronous Rate.

5.2.3 Gateway RTCN Services CSC Performance Requirements

1. The Gateway RTCN Services CSC shall provide change data packets to the RTCN at the system synchronous rate.

5.2.4 Gateway RTCN Services CSC Interfaces Data Flow Diagram



Gateway RTCN Services CSC is spawned by the Gateway Initialization CSC.

All communications with the RTCN are handled by the Gateway RTCN Services CSC. Commands and Responses are channeled to the Gateway Command and Response CSC. System Messages and System Events that are generated by the Utility Request CSC are also handled.

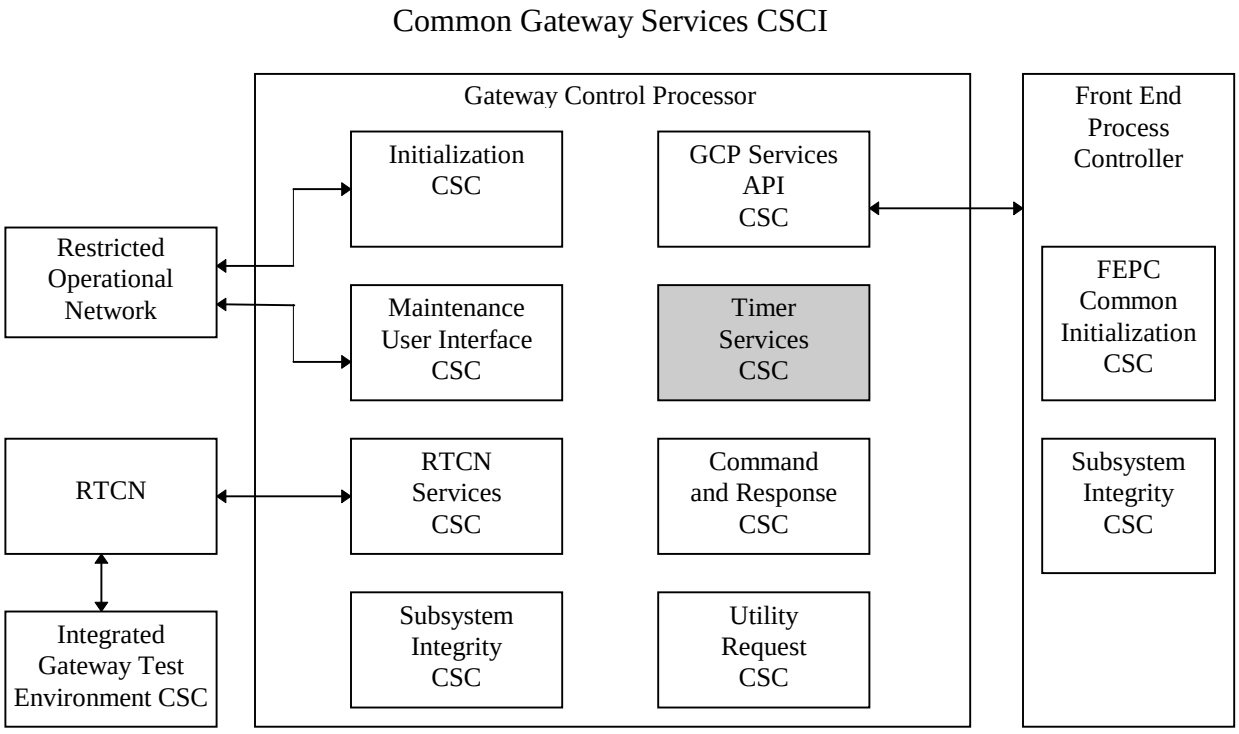
Change Data is read from the Change Data Shared memory Message Queue, stored in a packet and sent at the System Synchronous Rate. The System Synchronous Rate is provided by Gateway Timer Services CSC.

6. Gateway Timer Services CSC

6.1 Gateway Timer Services CSC Introduction

6.1.1 Gateway Timer Services CSC Overview

The Gateway Timer Services CSC is responsible for the different services needed by the Gateway when interfacing with the time card. It is part of the Common Gateway Services CSCI and is resident in the GCP.



6.1.2 Gateway Timer Services CSC Operational Description

The Gateway Timer Services CSC is responsible for providing the initialization routine for the time interface card. The Gateway Timer Services CSC will also provide services to read the time as provided by the time interface card, and will provide the System Synchronous Rate interrupt to the Gateway RTCN Services CSC.

6.2 Gateway Timer Services CSC Specifications

6.2.1 Gateway Timer Services CSC Groundrules

- Time access functions provided by Gateway Timer Services CSC will be packaged with the GCP Services API CSC's functions.

6.2.2 Gateway Timer Services CSC Functional Requirements

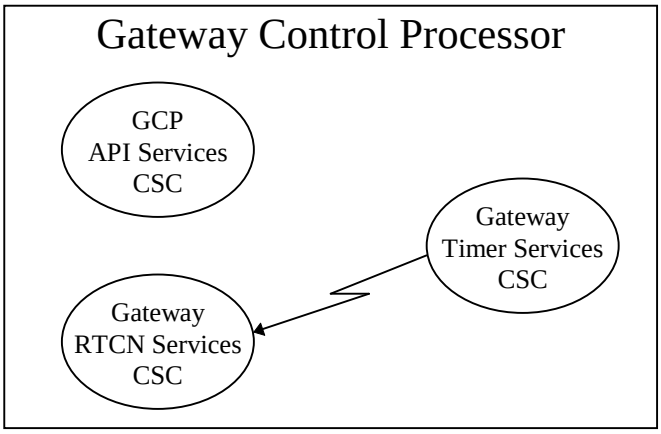
1. Gateway Timer Services CSC shall provide an initialization routine for the time board in the Gateway.

2. If available, Gateway Timer Services CSC shall use an external IRIG-B signal in order to synchronize the time of day.
3. Gateway Timer Services CSC shall provide a function to access the following:
   3.1. Time in BCD with micro-second resolution.
   3.2. Millisecond Time Of Day (32-bit integer).
   3.3. Julian Time Of Year, JTOY (32-bit integer).
4. Gateway Timer Services CSC will interrupt the Gateway RTCN Services CSC's Change Data Packet Builder at the system synchronous rate.

6.2.3 Gateway Timer Services CSC Performance Requirements

1. Gateway Timer Services CSC will return time within 10 μ seconds from the time of a request.

6.2.4 Gateway Timer Services CSC Interfaces Data Flow Diagram



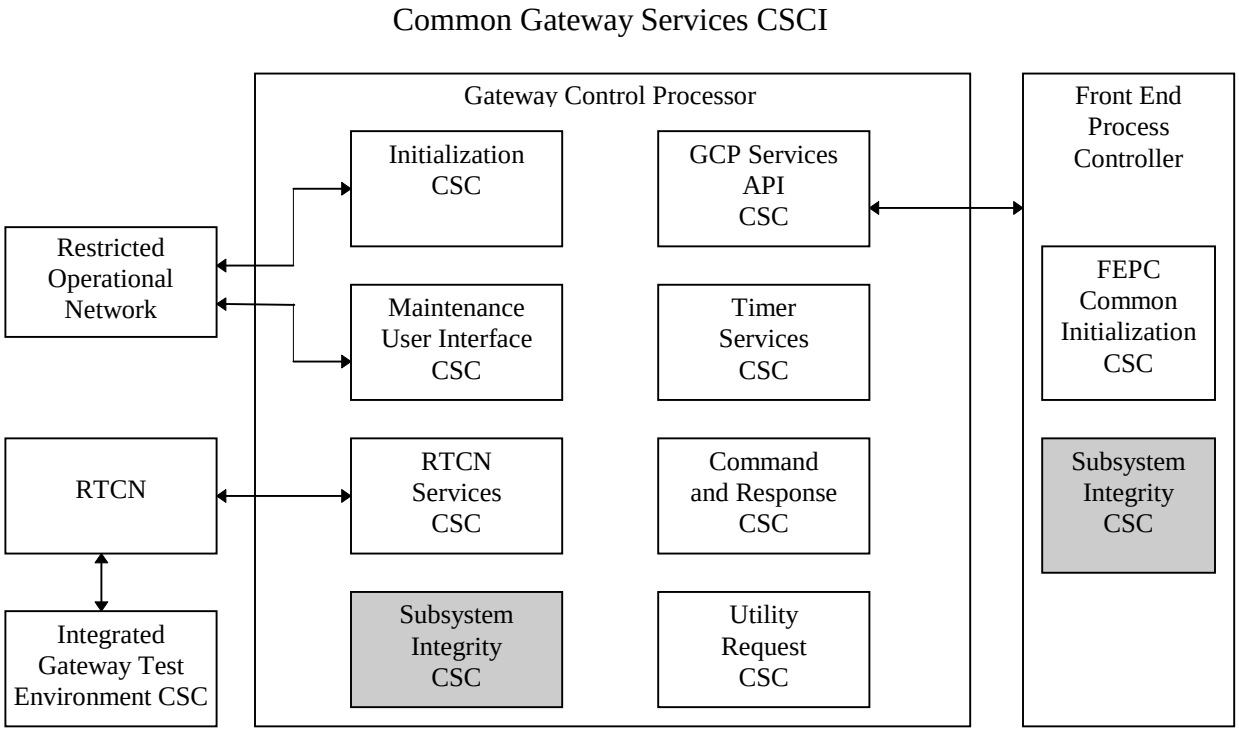
Gateway Timer Services CSC is spawned by the Gateway Initialization CSC. It provides System Synchronous Rate interrupts to the Gateway RTCN Services CSC. It also provides functions to read the time from the Gateway's time board. These functions are packaged with the GCP Services API CSC.

7. Gateway Subsystem Integrity CSC

7.1 Gateway Subsystem Integrity CSC Introduction

7.1.1 Gateway Subsystem Integrity CSC Overview

The Gateway Subsystem Integrity CSC is responsible maintaining task and board level integrity in the Gateway.



7.1.2 Gateway Subsystem Integrity CSC Operational Description

The Gateway Subsystem Integrity CSC is a set of tasks and tables that monitors the health of all tasks in the Gateway. Also, this CSC builds and maintains a Shared Memory area through which each CPU in the Gateway may update Health and Status information. This information is tracked closely by the Gateway Control Processor (GCP). A mechanism is provided by this CSC to automatically report Health and Status FDs on a cyclic basis. This CSC is responsible for the generation and reception of System Event codes. Gateway Subsystem Integrity is also responsible for recovery/termination in the case of a Gateway Health problem.

7.2 Gateway Subsystem Integrity CSC Specifications

7.2.1 Gateway Subsystem Integrity CSC Groundrules

- All Gateway Subsystem Integrity changed data will be written to the Change Data shared memory message queue. From there, Gateway RTCN Services CSC is responsible for including them as part of the Gateway Change Data output stream.
- Gateway task monitoring will not apply to VxWorks Operating System tasks (possible in a future release).

- Every monitored task in the Gateway will be assumed a Critical task unless that task explicitly declares itself as Non-critical.
- Test Build CSCI will provide each Gateway with a table correlating Heath and Status FD Names to Active and Stand-by FDIDs.
- An independent RTCN network stream will be provided by System Services CSCI for System Event codes.

7.2.2 Gateway Subsystem Integrity CSC Functional Requirements

The Functional Requirements for the Gateway Subsystem Integrity CSC are arranged in the following major functions:

1. Gateway Task Health and Status
2. Health and Status Function Designators
3. Gateway Processor Integrity
4. System Event codes

7.2.2.1 Gateway Task Health and Status

Gateway Task Health and Status is a set of task monitoring functions that will reside on every processor in the Gateway.

1. Gateway Subsystem Integrity shall build and maintain a Task Health Table on each processor in the Gateway which will store task Health and Status information.
2. Gateway Subsystem Integrity shall provide a Task registration function which will automatically reserve an entry in the Task Health Table whenever a task is created. This function will be called by the Initialization CSC for that processor (Gateway Initialization CSC, or FEPC Common Initialization CSC).
3. Gateway Subsystem Integrity shall provide a Task un-registration function which will automatically delete an entry from the Task Health Table whenever a task is deleted. This function will be called by the Gateway Initialization CSC.
4. Gateway Subsystem Integrity shall update all of a Gateway Processor's task entries in its Task Health Table (TBD) update rate period.
5. Gateway Subsystem Integrity shall verify the existence of all tasks every (TBD) update rate period.
6. Gateway Subsystem Integrity shall check the processing state of all tasks every (TBD) update rate period.
7. If a Critical task is found to be absent or suspended, Gateway Subsystem Integrity shall discontinue processing, attempt to send a System Event message, attempt to send a System Message, and perform Recovery.
8. If a Non-critical task is found to be absent or suspended, Gateway Subsystem Integrity shall send a System Message.

7.2.2.2 Cyclic Health and Status Function Designators

Cyclic Health and Status Function Designators are those FDs which require periodic updates. Gateway Subsystem Integrity CSC will provide a generic means of reporting these reliably.

1. Gateway Subsystem Integrity shall provide a registration function to allow other CSC's to register the address, size, and FD name for health/status FD's.
2. Gateway Subsystem Integrity shall maintain a list of health/status measurements and their associated FDID's.
3. Gateway Subsystem Integrity will scan this list and output all data which has changed at a (TBD) update rate.
4. Gateway Subsystem Integrity CSC shall provide the capability to output Cyclic Health and Status FD information on demand.

7.2.2.3 Gateway Processor Integrity

Gateway Processor Integrity consists of a Task and Shared Memory Area residing on the Gateway Control Processor (GCP). The Shared Memory Area contains a Health counter for each processor in the Gateway. It is the responsibility of each Gateway resident processor to update its count in this Shared Memory Area, and to verify the counts of the other processors in the Gateway.

1. Gateway Subsystem Integrity CSC shall build and maintain a Gateway Health Shared Memory Area on the GCP.
2. Gateway Subsystem Integrity shall update the Health counter for each Gateway processor upon which it resides.
3. If the GCP fails to update its Health count, the FEPC shall discontinue processing, command the GCP to discontinue processing, and perform Recovery.
4. If the FEPC fails to update its Health count, the GCP shall command the FEPC to discontinue processing, attempt to send a System Event message, attempt to send a System Message, and perform Recovery.
5. If all counts have been properly updated, Gateway Subsystem Integrity shall send a Gateway wide Health count to the Change Data shared memory message queue at a (TBD) rate.

7.2.2.4 System Event codes

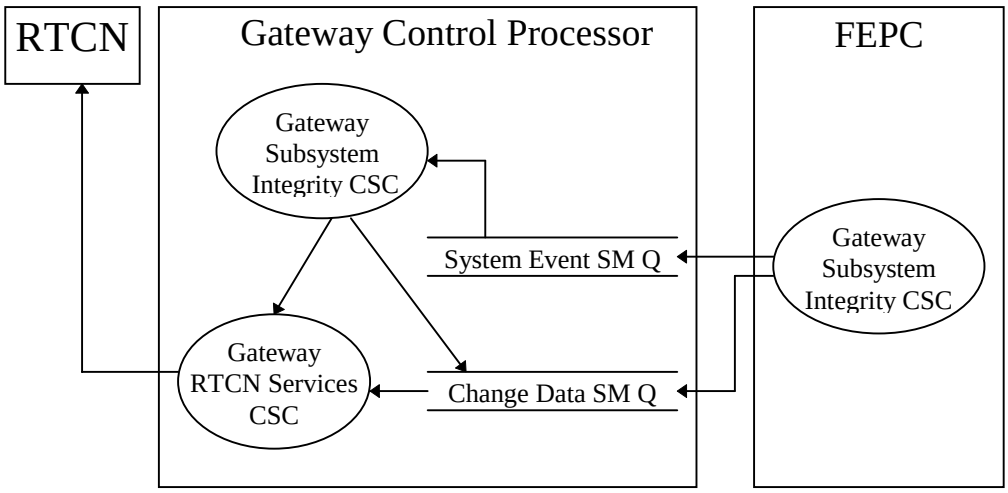
The System Event routines provide all processes on the Gateway the ability to send a System Event code.

1. Gateway Subsystem Integrity CSC shall provide an independent shared memory message queue and handling task for System Event processing.
2. Gateway Subsystem Integrity CSC shall provide a method for all resources on the Gateway to send System Event codes.
3. Under the following conditions the Gateway Subsystem Integrity CSC shall transmit the terminal System Event code:
   - 3.1. The Gateway Control Processor fails to update its Health Counter.
   - 3.2. The Front-End Process Controller fails to update its Health Counter.
   - 3.3. A Critical task on the Gateway is found to be absent or suspended.
   - 3.4. The FEPC requests a System Event code to be transmitted (using the shared memory queue).

7.2.3 Gateway Subsystem Integrity CSC Performance Requirements

1. Gateway Subsystem Integrity shall send Gateway Subsystem Integrity change data at a (TBD) rate.

7.2.4 Gateway Subsystem Integrity CSC Interfaces Data Flow Diagram



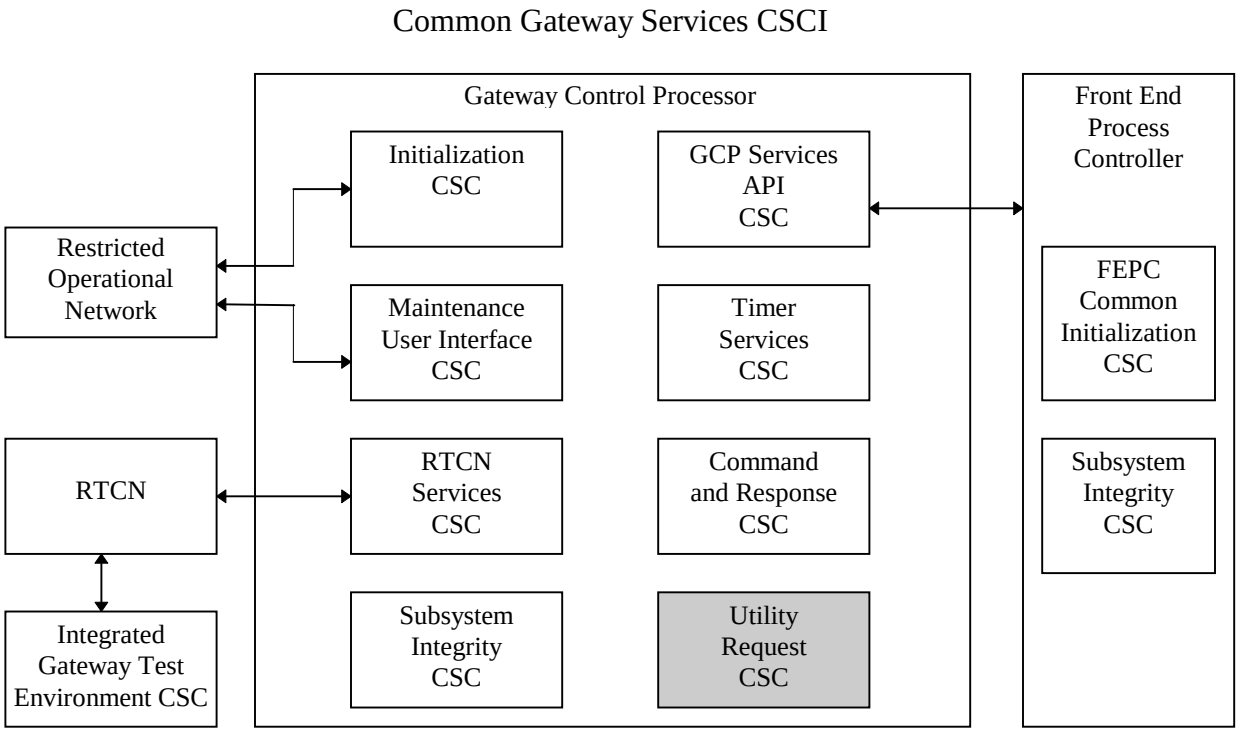
Gateway Subsystem Integrity CSC is spawned by the Gateway Initialization CSC. All Subsystem Integrity information is channeled through the Change Data Shared Memory Message Queue. From there, it is routed to the RTCN using the Gateway RTCN Services CSC.

8. Gateway Utility Request CSC

8.1 Gateway Utility Request CSC Introduction

8.1.1 Gateway Utility Request CSC Overview

The Gateway Utility Request CSC is responsible for transmitting System Messages, error logging and status logging. It is part of the Common Gateway Services CSCI and is resident in the GCP.



8.1.2 Gateway Utility Request CSC Operational Description

Gateway Utility Request CSC will provide the capability for any resource in the Gateway to generate System Messages via the RTCN. It will also provide the capability to log Error and Status messages to local disk. These error and status message can also be routed to the console port. Many metrics will be maintained by this CSC such as commands processed per second, etc. Gateway Utility Request also provides a Recovery Dump function which will dump all global and local variables to the disk.

8.2 Gateway Utility Request CSC Specifications

8.2.1 Gateway Utility Request CSC Groundrules

- Gateway Utility Request CSC will allow any resource in the Gateway to perform the below functions. These functions have been packaged with the GCP Services API CSC.
  - Generate System Messages,
  - Perform a Recovery Dump,
  - Log to local disk error/status messages,

  - Route error/status messages to the console port.

- The message number used to format System Messages will be defined in a header file that will be provided by the System Message Services CSC.
- The Gateway Maintenance User Interface CSC shall provide the means to access the detailed Gateway error descriptions provided by the Gateway Utility Request CSC.
- The Gateway Maintenance User Interface CSC shall provide the means to decode the local version of Recovery Dump provided by the Gateway Utility Request CSC.

8.2.2 Gateway Utility Request CSC Functional Requirements

The Functional Requirements for the Gateway Utility Request CSC are arranged in the following major functions:

1. System Messages
2. Error/Status logging
3. Recovery Dump

8.2.2.1 System Messages

The System Message routines provide all processes on the Gateway the ability to send a System Message.

1. Gateway Utility Request CSC shall provide an independent shared memory message queue and handling task for System Message processing.
2. Gateway Utility Request CSC shall provide a method for all resources on the Gateway to send System Messages.
3. Gateway Utility Request CSC shall provide the capability to specify System Message parameters.

8.2.2.2 Error/Status Logging

The Logging routines provide all processes on the Gateway the ability to log messages to the console port and/or the disk. Also, a means to register detailed descriptions of errors will be provided.

1. Gateway Utility Request CSC shall provide an independent shared memory message queue and handling task for Log Message processing.
2. Gateway Utility Request CSC shall provide a method for all resources on the Gateway to Log Error/Status messages to the Gateway disk and/or the console port.
3. Gateway Utility Request CSC shall provide the capability to specify Error/Status message parameters.
4. Gateway Utility Request shall provide a means to register a detailed description of error messages during development.
5. Detailed descriptions of error messages shall be stored as a database on the Gateway disk and will be accessible via the Gateway Maintenance User Interface CSC.
6. Gateway Utility Request CSC shall provide a header file mapping Gateway Errors to the Error/Status codes which have detailed descriptions in the database.
7. If an error has a detailed description associated with it, this shall be made known using a system message which references the database entry by message number.

8.2.2.3 Recovery Dump

A Recovery Dump occurs when a fatal error has been encountered on the Gateway. It is a means of dumping raw Gateway information to the Gateway disk before the Gateway is terminated.

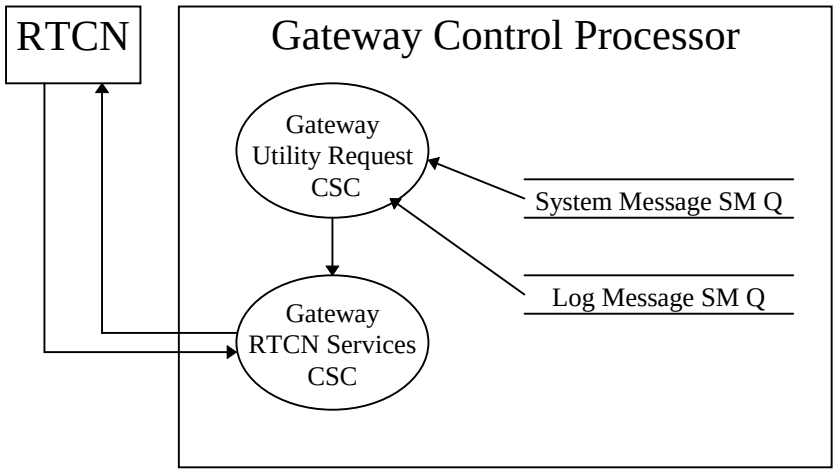
1. Gateway Utility Request CSC shall perform a Recovery Dump whenever a fatal error occurs in the Gateway.

2. Recovery Dumps shall be sent to SDC first, and then logged locally.
3. When a Recovery Dump occurs, all Gateway resident processors shall write the following information to the SDC and to the disk:
   3.1. All variables (global and local).
   3.2. Route Table, Transaction Table, and Streams Table (if GCP).
   3.3. All loaded TCID Tables (if FEPC).
   3.4. Reason for failure (if known).

8.2.3 Gateway Utility Request CSC Performance Requirements

No performance requirements have been identified for the Gateway Utility Request CSC for the Thor delivery.

8.2.4 Gateway Utility Request CSC Interfaces Data Flow Diagram



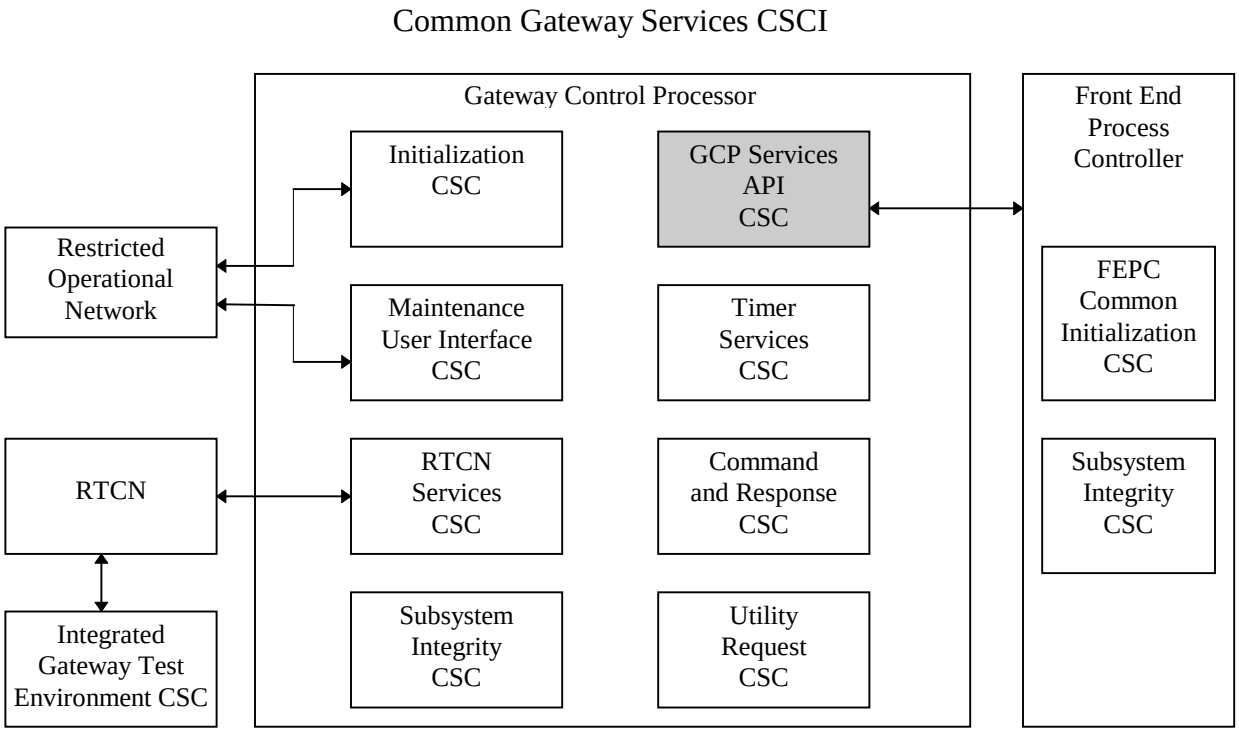
The Utility Request CSC is spawned by the Gateway Initialization CSC. The System Event, System Message, and Log Message Shared Memory Message Queues provide every resource in the Gateway with access to those services. All Utility Request CSC services that require the RTCN are routed to the Gateway RTCN Services CSC.

9. GCP Services API CSC

9.1 GCP Services API CSC Introduction

9.1.1 GCP Services API CSC Overview

The GCP Services API CSC is responsible for providing a common interface from the Front End Process Controller (FEPC) to the Gateway Control Processor (GCP) and is resident on the FEPC.



9.1.2 GCP Services API CSC Operational Description

This CSC provides a common interface to services provided by the GCP. These services include receiving commands from the RTCN and generating their response, sending change data or system messages, logging messages to the local hard drive or display, etc.

9.2 GCP Services API CSC Specifications

9.2.1 GCP Services API CSC Groundrules

- None

9.2.2 GCP Services API CSC Functional Requirements

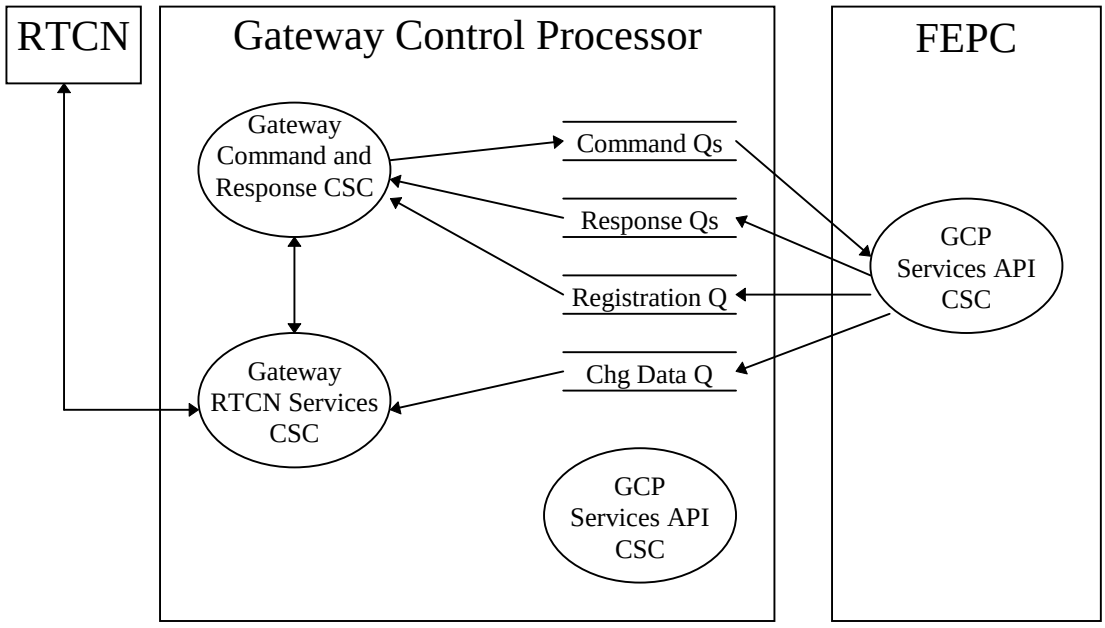
1. The GCP Services API will provide an interface for receiving commands from the RTCN.
2. The GCP Services API will provide a normal and high priority queue for receiving commands

3. The GCP Services API will provide an interface for sending commands to the RTCN.
4. The GCP Services API will provide an interface for receiving responses from the RTCN
5. The GCP Services API will provide an interface for generating command responses to the RTCN
6. The GCP Services API will provide an interface for sending measurement change data to the RTCN
7. The GCP Services API will provide an interface for sending system messages to the RTCN
8. The GCP Services API will provide an interface for sending system event codes to the RTCN
9. The GCP Services API will provide an interface for sending archive data to the RTCN
10. The GCP Services API will provide an interface for sending log messages to the local hard drive and/or to the console port and to the RTCN.
11. The GCP Services API will provide an interface for reading time.

9.2.3 GCP Services API Performance Requirements

No performance requirements have been identified for the GCP Services API CSC for the Thor delivery.

9.2.4 GCP Services API CSC Interfaces Data Flow Diagram



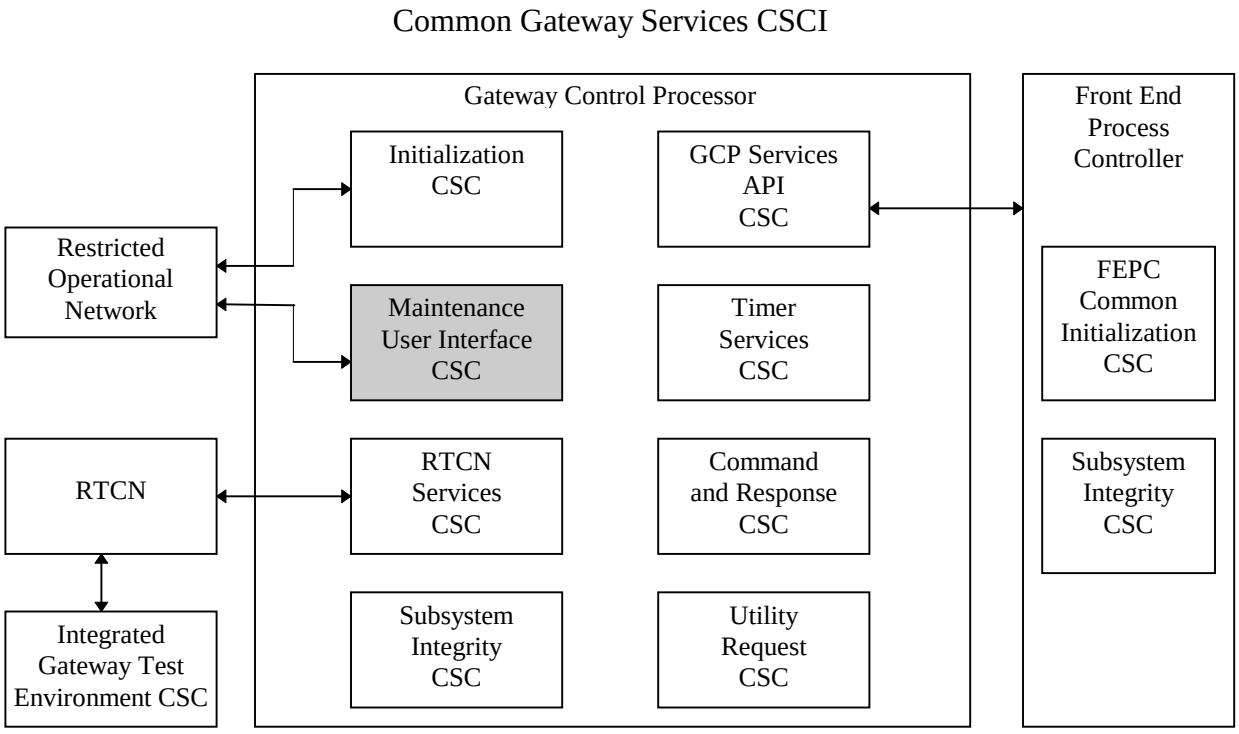
The GCP Services API CSC is initialized by the Gateway Initialization CSC. After Initialization, any Gateway resident processor (including the GCP) may use the API by registering through the Registration Shared Memory Message Queue. After registering, the capability to perform Command and Response functions may be accomplished through these Queues. They provide a direct link to the Gateway Command and Response, and Gateway RTCN Services CSCs.

10. Gateway Maintenance User Interface CSC

10.1 Gateway Maintenance User Interface CSC Introduction

10.1.1 Gateway Maintenance User Interface CSC Overview

The Gateway Maintenance User Interface CSC allows access to the Gateway via the Restricted Operational Network. It is part of the Common Gateway Services CSCI and is resident in the GCP.



10.1.2 Gateway Maintenance User Interface CSC Operational Description

Gateway Maintenance User Interface CSC will allow access to the Gateway via the Restricted Operational Network in order to access several Gateway maintenance features. It will allow access to Network statistics, Command and Data processing statistics, static tables resident on the Gateway, verbose error descriptions, and Health and Status information. The Interface will also have the capability to call some Gateway commands.

10.2 Gateway Maintenance User Interface CSC Specifications

10.2.1 Gateway Maintenance User Interface CSC Groundrules

- The Gateway Maintenance User Interface CSC will not be available in Primitive mode.
- Updates to the Gateway Maintenance User Interface CSC's counts and table displays will be no more frequent than once per second.
- The Gateway Maintenance User Interface CSC will use the internal Route Code 0 to send commands to the FEPC in the Gateway.

- The Gateway Maintenance User Interface CSC will be available only over the Restricted Operational Network.
- The IGTE will not be used in an operational environment.

10.2.2 Gateway Maintenance User Interface CSC Functional Requirements

The Functional Requirements for the Gateway Maintenance User Interface CSC are arranged in the following major functions:

1. Initialization
2. Command and Response
3. RTCN Services
4. Timer Services
5. Subsystem Integrity
6. Utility Request
7. FEPC Specific

10.2.2.1 Initialization

The Initialization aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway Initialization CSC.

1. The Gateway Maintenance User Interface CSC shall be able to display Gateway Control Processor (GCP) and Front End Processor Controller (FEPC) Initialization modes.
2. The Gateway Maintenance User Interface CSC shall be able to display the TCIDs available on the Gateway disk.
3. The Gateway Maintenance User Interface CSC shall be able to display ASCII Tables located on the Gateway disk (e.g., TCID Tables, Multicast Streams Table).

10.2.2.2 Command and Response

The Command and Response aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway Command and Response CSC.

1. The Gateway Maintenance User Interface CSC shall be able to send internal commands to the FEPC using the Gateway Command and Response CSC.
2. The Gateway Maintenance User Interface CSC shall be able to track display command and response performance statistics.

10.2.2.3 RTCN Services

The RTCN Services aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway RTCN Services CSC.

1. The Gateway Maintenance User Interface CSC shall be able to display the Network Streams Table provided by the Gateway RTCN Services CSC.
2. The Gateway Maintenance User Interface CSC shall be able to display RTCN Network statistics for the Gateway.

10.2.2.4 Timer Services

The Timer Services aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway Timer Services CSC.

1. The Gateway Maintenance User Interface CSC shall be capable of displaying the current Gateway time.
2. The Gateway Maintenance User Interface CSC shall be capable of setting the Gateway's Time Of Day clock.

10.2.2.5 Subsystem Integrity

The Subsystem Integrity aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway Subsystem Integrity CSC.

1. The Gateway Maintenance User Interface CSC shall have read access to all board health counts.

10.2.2.6 Utility Request

The Utility Request aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that pertains to the Gateway Utility Request CSC.

1. The Gateway Maintenance User Interface CSC shall be able to display System Message, System Event, and Error counts.
2. The Gateway Maintenance User Interface CSC shall be able to display Restricted Operational Network statistics for the Gateway.
3. The Gateway Maintenance User Interface CSC shall be able to display Shared Memory Message Queue information.
4. The Gateway Maintenance User Interface CSC shall be capable of decoding the local version of a Recovery Dump provided by Gateway Utility Request CSC.
5. The Gateway Maintenance User Interface CSC shall be capable of displaying the detailed error descriptions provided by the Gateway Utility Request CSC.

10.2.2.7 FEPC Specific

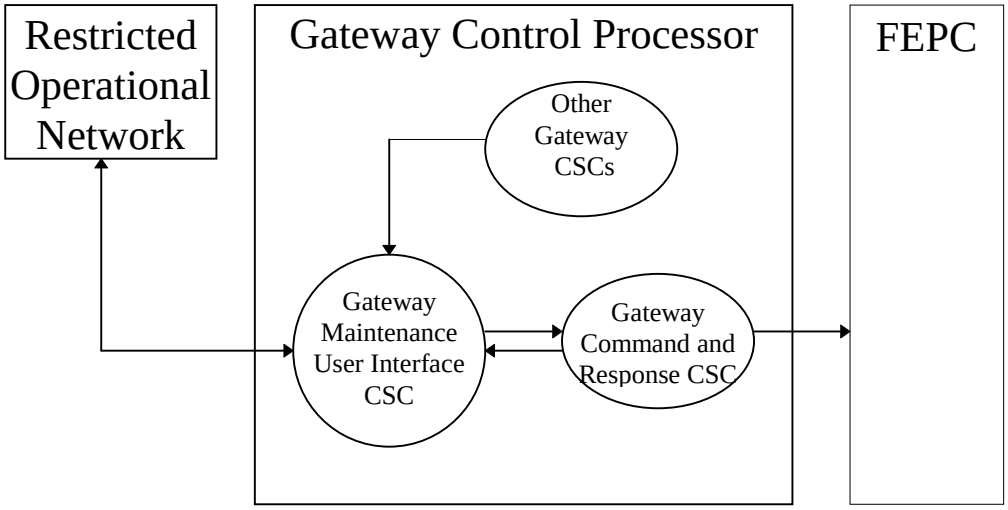
The FEPC Specific aspect of the Gateway Maintenance User Interface CSC is the set of the CSC's capabilities that are unique to the type of FEPC in the Gateway.

1. The Gateway Maintenance User Interface CSC shall be able to decode and display information from the Gateway specific Shared Memory Area.

10.2.3 Gateway Maintenance User Interface CSC Performance Requirements

No performance requirements have been identified for the Gateway Maintenance User Interface CSC for the Thor delivery.

10.2.4 Gateway Maintenance User Interface CSC Interfaces Data Flow Diagram



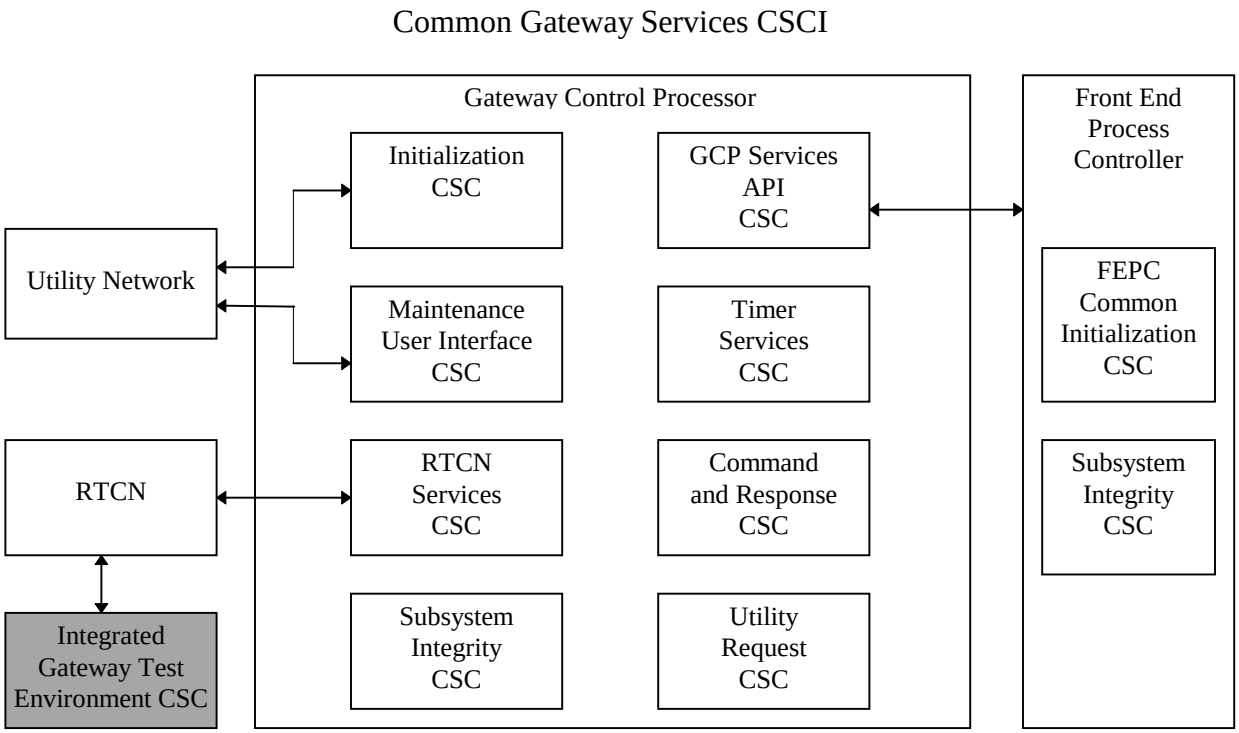
The Gateway Maintenance User Interface CSC is a server which handles client requests over the Restricted Operational Network. Requests which require commands to the FEPC are implemented using the Gateway Command and Response CSC. All other requests are handled by reading information from the other Gateway CSCs.

11. Integrated Gateway Test Environment CSC

11.1 Integrated Gateway Test Environment CSC Introduction

11.1.1 Integrated Gateway Test Environment CSC Overview

The Integrated Gateway Test Environment CSC is responsible for testing the LDB, GSE, PCM and SIM Gateways. It is part of the Common Gateway Services CSCI and is and will be resident on the testing platform. The testing platform can be a SunOS or IRIX machine that has access to the RTCN.



11.1.2 Integrated Gateway Test Environment CSC Operational Description

The Integrated Gateway Test Environment CSC is a fully graphical integrated environment that will allow developers to test their Gateway systems verifying design requirements. The main IGTE will consist of a Change Data Packet Analyzer, the Initialization Command Generator, and the Gateway Command Generator.

11.2 Integrated Gateway Test Environment CSC Specifications

11.2.1 Integrated Gateway Test Environment CSC Groundrules

- The IGTE will support the following Gateways
  - Launch Data Bus Gateway
  - Ground Support Equipment Gateway
  - Pulse Code Modulation Gateway
  - Simulation Gateway

- All communication between the IGTE and the Gateways will be via the RTCN.
- The Tool Command Language (TCL) COTS package is required to use the IGTE.
- The IGTE will use the System Services CSCI's Multicast streams file for establishing an RTCN connection.

11.2.2 Integrated Gateway Test Environment CSC Functional Requirements

The Functional Requirements for the Integrated Gateway Test Environment CSC are arranged in the following major/minor functions:

1. IGTE Configuration Options GUI
2. Initialization Command Generator
3. Gateway Command Generator
4. Change Data Analyzer
5. Function Designator Tracking Tool
6. HCI Applications Interface

11.2.2.1 IGTE Configuration Options GUI

The IGTE Configuration GUI will be the main configuration display for the IGTE. It is here that the user can change any sort of configuration item in the IGTE.

1. Connection to Gateways using the IGTE shall be by Multicast Data Stream.
2. The IGTE shall support all Muticast Data Streams available in the Multicast Streams Table.

11.2.2.2 Initialization Command Generator

The Initialization Command Generator is how the IGTE emulates the Ops CM Server on the RTCN. A command that is chosen in the user interface will be encoded and sent over the Ops CM stream. After the command is sent the application will wait for a response.

1. All Initialization command and response packets shall be available for display at the user's request.
2. Upon response of a non-zero completion code, the IGTE shall alert the user and inform what type of code was received.
3. The IGTE shall be capable of generating and responding to all Gateway Initialization commands.

11.2.2.3 Gateway Command Generator

The Gateway Command Generator will send the requested commands over the CCP data stream. The user interface will list all of the available commands and attributes associated with them for command creation.

1. Commands will be organized by Gateway type.
2. All Command Generator command and response packets shall be available for display at the user's request.

11.2.2.4 Change Data Analyzer

The Change Data Analyzer will read change data packets from any Change Data Stream and display them in the IGTE. The packet will be decoded so it can be easily understood.

1. When the Change Data Analyzer is activated, the IGTE shall read RTCN Change Data Packets into a buffer.
2. The IGTE Change Data Packet buffer size shall be configurable.
3. The IGTE shall decode the Change Data packet's header and body to be easily decipherable.
4. The IGTE shall support the decoding of all Change Data body types.
5. The IGTE shall provide Start and Pause capabilities while reading from the RTCN.
6. The IGTE shall have the capability to clear the buffer so a fresh set of packets can be retrieved.

7. The IGTE shall be capable of filtering out Change Data packets with no packet bodies.

11.2.2.5 Function Designator Tracking Tool

The Function Designator Tracking Tool will allow developers to select one or many FD's and monitor their current values as they change on the RTCN.

1. The IGTE shall support real time monitoring of selected FD's via the Change Data stream.
2. The IGTE shall support a maximum of five simultaneously tracked FD's.
3. The IGTE shall support the historical graphing of FD's (Post-Thor).

11.2.2.6 LDB Applications Interface

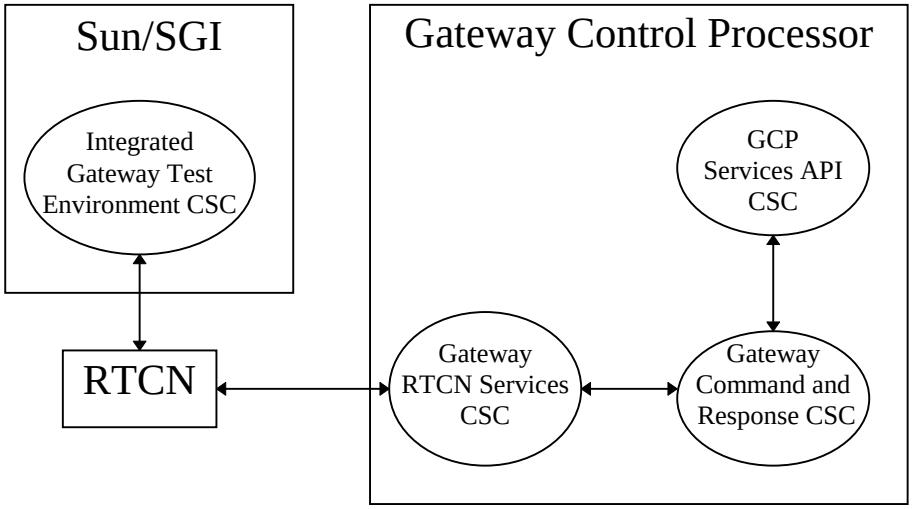
The LDB Applications Interface will be the connection to front-end applications from the IGTE. Graphical LDB applications that are sending and receiving packets will be able to connect to the IGTE so their command and response packets can be analyzed while still maintaining the full functionality of the application.

1. The IGTE shall provide an API to for the LDB Applications Interface.
2. LDB applications shall interface to the IGTE via C procedural calls. (send and read response)

11.2.3 Integrated Gateway Test Environment CSC Performance Requirements

No performance requirements have been identified for the Integrated Gateway Test Environment CSC for the Thor delivery.

11.2.4 Integrated Gateway Test Environment CSC Interfaces Data Flow Diagram



The communication to any Gateway using the IGTE CSC will be over the RTCN.